THE BRITISH ASSOCIATION

REPORTS

Tabular View of the Classification of the Labyrinthodonta, by L. C. Miall. Summary of the Second Report on Labyrinthodonta.

AMPHIBIA

LABYRINTHODONTA.

A.—*Centra of dorsal vertebræ discoidal.*[1]—Genera 1 to 25.

I.—EUGLYPTA. Cranial bones strongly sculptured. Lyra conspicuous. Mandible with well-developed post-articular process. Teeth conical; their internal structure complex; dentine much folded. Palato-vomerine tusks in series with small teeth. Short inner series of mandibular teeth. Sculptured thoracic plates, with reflected process upon the external border.

* *Palatine foramina large, approximated.*

† *Mandible with an internal articular buttress.*

‡ *Orbits central or posterior.*

1. Mastodonsaurus, Jäger.
2. Capitosaurus, Munst.
3. Pachygonia, Huxley (?).
4. Eurosaurus, D'Eichwald (?).
5. Trematosaurus, Braun.
6. Gonioglyptus, Huxley.

‡‡ *Orbits anterior.*

7. Metopias, Von Meyer.
8. Labyrinthodon, Owen.[2]

†† *Mandible without internal articular buttress.*

9. Diadetognathus, Miall.

** *Palatine foramina small, distant.*

10. Dasyceps, Huxley.
11. Anthracosaurus, Huxley.

II.—BRACHYOPIDA. Skull parabolic. Orbits oval, central or anterior. Post-articular process of mandible wanting (?).

12. Brachyops, Owen.
13. Micropholis, Huxley.
14. Rhinosaurus, Waldheim.
15. Bothriceps, Huxley.

III.—MALACOCYLA. Skull vaulted, triangular, with large postero-lateral expansions. Lyra consisting of two nearly straight longitudinal grooves, continued backwards as ridges. Orbits large, posterior, irregular. Temporal depressions, passing backwards from orbits. No post-articular process to mandible.[3]

* *Teeth with large anterior and posterior cutting edges.*

16. Loxomma, Huxley.

** *Teeth conical.*

17. Zygosaurus, D'Eichwald.

IV.—ATHROÖDONTA. Maxillary teeth wanting. Vomerine teeth aggregated. Orbit imperfect.

18. Batrachiderpeton, Hancock and Atthey.
19. Pteroplax, Hancock and Atthey.[4]

[V.—An uncharacterised group for the reception of some or all of the following genera.]

20. Pholidogaster, Huxley.
21. Ichthyerpeton, Huxley.
22. Pholiderpeton, Huxley.
23. Erpetocephalus, Huxley.

VI.—ARCHEGOSAURIA. *Von Meyer.* Vertebral column notochordal. Occipital condyles unossified.

24. Archegosaurus, Goldfuss.
25. Apateon,[5] Von Meyer.

B.—*Centra of dorsal vertebra elongate, contracted in the middle.*

VII.—HELEOTHREPTA. Skull triangular, with produced, tapering snout. Orbits central. Mandibular symphysis very long, about one-third of the length of the skull.

26. Lepterpeton, Huxley.

VIII.—NECTRIDEA. Epiotic cornua much produced. Superior and inferior processes of caudal vertebræ dilated at the extremities and pectinate.

27. Urocordylus, Huxley.
28. Keraterpeton, Huxley.

IX.—AISTOPODA. Limbs wanting.

29. Ophiderpeton, Huxley.
30. Dolichosoma, Huxley.

X.—MICROSAURIA, *Dawson.* Thoracic plates unknown. Ossification of limb-bones incomplete. Dentine non-plicate, pulp cavity large.

31. Dendrerpeton, Owen.
32. Hylonomus, Dawson.
33. Hylerpeton, Owen.

[1] This character is not of primary importance, but seems to be available for an arrangement determined by other considerations.
[2] Orbits unknown.
[3] Loxomma.
[4] The vomerine teeth are unknown, and this genus may therefore require to be removed.
[5] Of doubtful distinctness.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the Photographic Operations connected with the coming Transit of Venus, by Captain Abney, R.E., F.R.A.S.

As is doubtless well known to all, there will be an application of photography to register the passage of Venus across the sun's disc, and it may not be amiss to give an outline of the processes, &c., that will be adopted. It has been determined by the Astronomer Royal that at every photographic station a photograph shall be taken every two minutes during the transit, and it has been a matter of considerable labour to work out a process that will admit of such a large number of negatives being taken in a hot climate. In Kerguelen's Land it would be perfectly feasible to adopt the ordinary wet process, the low temperature admitting of it, but in a temperature of 90° F. the evaporation of the volatile constituents of the collodion would render such a procedure inapplicable, as all practical photographers will admit. In India, where I have worked extensively, coating two or three plates in succession in a large-sized tent has sometimes proved injurious. With such experience I venture to think that it would have been madness to trust to the wet method for four hours, unless the conditions of *personnel* of the parties were considerably altered. Sir G. Airy, after much anxious deliberation, and with the advice (and that not hastily formed, by any means) of Mr. De la Rue, determined to adopt a dry process if practicable. After considerable experiments conducted at Chatham, it was determined to adopt an albumen dry process, using a highly bromised collodion, and strong alkaline development. There were several advantages in this:—(1) At the critical time the photographers would have nothing to distract their attention excepting placing the dry plates in the slide and developing every twelfth plate exposed, in order to regulate the exposure; (2) the irradiation was much diminished by the use of albumen, a point of no small importance when measurements have to be taken; (3) the shrinkage of the film is reduced to zero when the plates are properly prepared.

In regard to the first advantage claimed, it will be apparent that plates prepared at leisure will have a much superior advantage to those prepared in the hurry of the moment as would be the case with wet plates. The chances of stains and spots are diminished tenfold, and we may expect a much clearer picture.

The true explanation of irradiation has been argued of late in NATURE, and perhaps I may be pardoned for dwelling an instant on that point. Irradiation may be divided into two kinds, viz., that occurring from reflection from the back of the plate, and that occurring from reflection from the particles of bromide or iodide of silver in the collodion film. The first requires no explanation. If a film be insufficiently dense and of such a colour as will cut off the most active rays of the spectrum, no irradiation on that account need be anticipated. Iodide of silver fulfils this condition much more fully than does bromide of silver, the former approaching to a yellow colour, whilst the latter is almost white. A thin layer of iodide is much more efficient in cutting off the blue end of the spectrum than is the bromide; hence, if irradiation through reflection from the back of the plate is to be overcome, it is wise to use a certain proportion of iodide in the collodion. Practically I have found that in the dry process under consideration, three parts of iodide to two of bromide give the best results without diminishing the sensitiveness of the film. The second cause of irradiation, viz., reflection from the particles of bromide and iodide, is not hard to explain. When a colloid body such as gelatine or albumen is brought in contact with a soluble salt of silver, the resisting compound is found to be one which is singularly free from this defect. If a ray of light be allowed to fall at right angles upon a very thin cell containing an emulsion of bromide of silver, the cell having worked glass sides and ends, it will be found that the ray of light will be scattered considerably, apparently in a logarithmic curve; the surface nearest the source of light will not be affected, but it will spread from that surface towards the other, a physical line of light becoming an area. If, however, a colloidal salt of silver be introduced it will be found that this area is much diminished,

and for small distances becomes inappreciable. In connection with this I may mention that bromide plates, even when backed with a non-actinic backing in optical contact with the plate, will give irradiation with alkaline development, whilst with acid development the irradiation will disappear. The explanation is not far to seek—the alkaline development reduces the silver *in situ*, the acid development deposits silver on the surface and where there is most attractive force. In the former case, the dispersed light acting on the interior of the film, causes the necessary change in the bromide of silver to effect reduction. Daguerreotype plates are not free from irradiation as has been supposed, though, owing to the extraordinary thinness of the iodide of silver, but little effect can be traced unless very prolonged exposure be given.

In the dry process selected for the transit of Venus it has then been thought desirable to have a rather dense film containing a proportion of iodide of silver and a colloid body—albumen—as preservative. I am not unmindful of the fact that different pyroxylines more or less affect irradiation, and we have altered the constitution of the pyroxyline in the collodion I shall use, by adding certain proportions of water; this materially aids the annihilation of irradiation from these plates.

For registering the time of external and internal contact of the planet with the sun's disc, the method known as Janssen's has been adopted, viz., causing a fresh portion of a plate to be exposed every second during the critical time, to the sun's limb, at that part where the contact will take place. Mr. Christie and Mr. De la Rue have both devised a slide for this purpose. The English parties use that designed by the former, whilst Colonel Tennant will use that by the latter. Shrinkage in the film has been carefully looked for by Dr. Vogel, of Berlin, and also by myself. Photographing a grating of 200 lines to the inch by contact printing, and measuring the results, I have been unable to find any alteration in the distances of the lines at any part of the film, hence I feel confident that any shrinking that can take place will be so small as to be negligible. The Russian parties are, I believe, going to use a grating material of iron wires. If shrinkage does occur this would be necessary, but it seems almost useless, in fact hurtful, where there will be none. There must be a certain error introduced due to the grating itself. The method of finding the angle of the position of the wires will be determined photographically. Two pictures of the sun will be taken at an interval of one minute on the same plate. The line forming the intersection of the sun's images will give the angle of position of the wires when measured by the micrometer. At each station the photographic party will consist of one officer and three sappers, all of whom have been trained in the use of the photo-heliograph and the process employed. A drill for each operation has been devised, and it is anticipated that the dangers of excitement during the critical times have been overcome by this arrangement. Practice on a mock transit has ensured a thorough knowledge of each phase of the phenomena; and I apprehend that discipline combined with a trust in their superiors will have annihilated one source of failure.

On the importance of improved methods of Registration of Wind on the Coast, with a notice of an Anemometer, designed by Mr. W. De la Rue, F.R.S., to furnish telegraphic information of the occurrence of strong winds, by Robert H. Scott, M.A., F.R.S.

It is hardly necessary to draw the attention of the Section to the fact that the configuration of the earth's surface exercises an overwhelming influence on the wind both as to its direction and force. Some statements and tables contained in a paper of mine in the last number of the *Quarterly Journal* of the Meteorological Society * abundantly prove this assertion, and it is therefore easy to see what an imperfect representation of the actual force of the wind at sea can be furnished by reports from a broken and mountainous coast, such as the Atlantic coasts of Ireland and Scotland, where the telegraphic stations are perforce situated in sheltered places, inasmuch as harbours are naturally found where there is as little exposure to wind as is possible.

In the practice of weather telegraphy and storm warnings, as the number of reports received per day from each station is strictly limited, on financial considerations, it is quite obvious that if the actual epoch of the commencement of a gale does not fall within the hours of attendance at the Telegraphic Office and at the Meteorological Office, which practically only extend from 8 A.M. till 3 P.M., much time will be lost in sending news of the fact to London. If it commences at 6 P.M. at Valencia, we cannot hear of it in London till 9 A.M. next morning.

On the other hand, if the observer be living in a sheltered spot, such as Plymouth, Nairn, or Greencastle, we shall not get a true report of the gale at all, inasmuch as the observer will not have felt it himself.

The first-named defect in our system can only be met by a considerably increased expenditure on the service, and that is not a scientific, but an administrative question, with which the Government can alone deal.

In order to meet the second difficulty, Mr. De la Rue has kindly devised an instrumental arrangement, by which the fact of any given force of wind having been reached at an exposed point (such as Rame Head for Plymouth, or Malin Head for Greencastle), can be at once conveyed to the reporter in his own office, or even to the central office in London. The instrument has been made by Messrs. Negretti and Zambra.

The following is the construction of the new signalling anemometer.

To the ordinary Robinson's anemometer spindle is affixed a toothed wheel, which is geared with another and larger toothed wheel fixed on a second vertical spindle which carries a centrifugal governor. The governor spindle is made to rotate at one-half or one-third of the velocity of the anemometer spindle in order that the rods carrying the governor balls may not have to be made inconveniently short. A provision is made for adjusting the length of the arms of the governors so that different wind velocities may be indicated within certain limits.

The governor balls act in the well-known way and expand when driven at a given rate, and the upward motion of these governor balls is used to raise a secondary wheel to bring into gear a third spindle on which is fixed the armature of a magneto-electric apparatus, which, like Sir Charles Wheatstone's instruments, consists of a compound permanent magnet with four soft iron cores, two of which are mounted on the north pole of the magnet and two on the south pole; these iron cores are surrounded with fine insulated copper wire, and on rotation of the armature give alternate + and − currents, in rapid succession according to the rate at which the armature is driven. These currents are conveyed inland to the observing station by insulated wires, and give warning by ringing an alarum as long as the anemometer cups are revolving at a velocity sufficient to raise the governor balls so as to bring the magneto-electrical apparatus into gear.

We see, therefore, that by adjusting the governors of the apparatus to indicate any required speed, a warning will at once be given when the wind reaches that speed, be it that of 60, 40, or 20 miles an hour, as may be required.

All the attention which the instrument requires after the apparatus is fixed is to lead two insulated wires from the anemometer into the observing station, and to connect these wires to the two terminals on the alarum.

In order to enable the observer to communicate at once and at as little expense as possible, to London, the fact of the velocity in question having been reached, the individual stations might be known by letters or symbols which might simply be telegraphed to London as an announcement that the alarum was acting at the station in question.

It is obvious that this plan is exceedingly simple, and there seems little reason why it should not be thoroughly efficacious, if only the registering portion of the apparatus can be properly protected from wilful damage by mischievous persons.

As usual, we are met by the question of cost, not only of the apparatus but of the connecting wires, and last, though not least, of the transmission of the messages. To enable us to render our service more effective than it is we must be supplied with the sinews of war. The 3,000*l*. which is the very utmost we spend annually on telegraphy, including salaries, rent, and every item, is but small compared with the 50,000*l*. *entirely exclusive of salaries* with which the chief signal office of the United States is so munificently endowed.

On the Source from which the Kinetic Energy is drawn which passes into Heat in the Movement of the Tides, by John Purser, M.R.I.A., Professor of Mathematics in the Queen's University.

Attention has of late years been directed by Mayer, Prof. James Thomson, and others, to the fact that the friction of the tidal currents on the bed of the ocean exercises an effect in retarding the earth's rotation on its axis.

The late eminent French astronomer, Delaunay, was the first, as far as I am aware, to form a numerical estimate of the possible magnitude of this effect, and to suggest that it furnishes a not

* "An attempt to establish a Relation between the Velocity of the Wind and its Force (Beaufort Scale), with some remarks on Anemometrical observations in General," by Robert Scott, F.R.S. Quart. Journ. of Met. Soc. vol. ii. p. 109.

improbable solution of that part of the secular inequality in the moon's mean motion which remains still unexplained.

He pointed out that inasmuch as the axis of the tidal spheroid is always behind the moon's place, a couple is exerted by the forces of the moon's attraction, which on the one hand retards the rotation of the earth, and on the other increases the dimensions of the lunar orbit.

This alteration of the lunar orbit prevents us from concluding, as we should otherwise do, that the kinetic energy which passes into heat in the movement of the tides has for its exact equivalent a corresponding quantity drawn from the store laid up in the earth's rotation on its axis.

The object of the present communication is to examine whether we can assert such an equivalence to hold approximately, and if so, to what degree of approximation. The question was started some years ago by the Astronomer Royal in the Astronomical Notices for the year 1866.

It occurred to the author that we might arrive at a solution of the problem from the information given us by the equation of energy combined with that of the conservation of angular momentum.

Let us in the first place take the case of a binary system consisting of the earth and moon, but suppose the plane of the earth's equator to coincide with that of the lunar orbit. If Q denote the energy which, during a given interval, passes into heat through tidal action, then, assuming the moon spherical and her rotation consequently unaltered, $Q = -\delta$ (energy of earth's rotation) $-\ \delta$ (energy of lunar orbit). By the energy of the lunar orbit is denoted the kinetic energy of the revolution of the earth and moon round their common centre of gravity, together with the potential energy of their separation.

Now the energy of orbit $=$ constant $- \frac{1}{2}\, m\, m^1 \mu\, \frac{1}{a}$, where $m\, m^1$ represent the masses of the two bodies, μ the unit of attractive force, and a the mean distance.

Hence $Q = -\delta$ (energy of earth's rotation) $- \frac{1}{2}\, m\, m^1\, \mu\, \frac{\delta a}{a^2}$.

Let h denote the angular momentum of the revolution of the two bodies round their common centre of gravity, H the angular momentum of the earth's rotation, then

$$\delta H = -\,\delta h$$

but

$$h = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \sqrt{a}\, \sqrt{1 - e^2}$$

$$\therefore\ \delta h = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ \sqrt{1 - e^2}\ \frac{\delta a}{2\sqrt{a}} - \frac{\sqrt{a} \,.\, e\, \delta e}{\sqrt{1 - e^2}} \right\}$$

When the excentricity is small the second term in this expression may be shown to be negligible when compared with the first, and we may write

$$\delta H = -\,\delta h = -\,\frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}}\ \frac{\delta a}{2\sqrt{a}}$$

$$\therefore\ Q = -\,\delta\,(\text{energy of earth's rotation}) + \frac{\sqrt{m + m^1} \,.\, \sqrt{\mu}}{Q^{\frac{3}{2}}}\ \delta H$$

Or if I denote the moment of inertia of the earth round her axis,

ω her angular velocity of rotation,

Ω the mean angular velocity of the moon in her orbit,

$$Q = -\,I\,\omega\,\delta\,\omega + I\,\Omega\,\delta\,\omega$$

$$\therefore\ -\,I\,\omega\,\delta\,\omega = \frac{Q}{1 - \frac{\Omega}{\omega}}$$

The left-hand member represents the loss of energy due to the slackening of the earth's rotation, and as Ω has the same sign as ω, we learn that not only is all the energy Q which is turned into heat in the motion of the tides drawn from the earth's rotation, but that, as a necessary concomitant, additional energy is transferred from the earth's rotation to the store at potential and actual energy, corresponding to the orbital motion of the system.

It also follows that when Ω is small compared to ω [in the actual case $\frac{\Omega}{\omega} = \frac{1}{27}$ nearly], the energy so transferred bears a very small ratio to Q, and that the energy lost in the earth's rotation is almost the exact equivalent of that consumed in tidal friction.

Let us now consider the case which we actually have to deal with, where the plane of the earth's equator does not coincide with the plane of the orbit.

Let G represent the resultant angular momentum of the system which will be fixed in magnitude and in direction.

θ, Θ the angles which the planes of h and H make with the plane of G.

Then, since $H^2 = G^2 + h^2 - 2\, G\, h \cos\theta$

$$H\,\delta H = (h - G\cos\theta)\,\delta h + G\,h \sin\theta\,\delta\theta$$

$$\therefore\ H\,\delta H = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ (h - G\cos\theta)\,\frac{\delta a}{2\sqrt{a}} + G\sqrt{a}\,\sin\theta\,\delta\theta \right\}$$

$$\text{Or, } \delta H = \frac{m\, m^1 \sqrt{\mu}\,\sqrt{a}}{\sqrt{m + m^1}} \left\{ -\cos(\Theta + \theta)\,\frac{\delta a}{2a} + \sin(\Theta + \theta)\,\delta\theta \right\}$$

The author proves from a calculation of the disturbing reactionary forces exercised by the tidal protuberances that the variations $\delta\theta$ and $\frac{\delta a}{2a}$ are of the same order of magnitude, although their exact ratio cannot be determined without far more complete data respecting the tides than we at present possess.

Let the ratio of the first of these variations to the second be denoted by λ, then

$$\delta \mathrm{H} = -\,\frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ 1 - \lambda \tan(\Theta + \theta) \right\} \frac{\delta a}{2\sqrt{a}}$$

$$\therefore\ -\,\mathrm{I}\,\omega\,\delta\omega = I \left\{ 1 - \frac{\Omega}{\omega}\ \frac{\sec(\Theta + \theta)}{1 - \lambda\,(\tan\Theta + \theta)} \right\}^{-1}$$

We may therefore still infer that since Ω is small compared to ω, the energy lost in the earth's rotation is almost the exact equivalent of that consumed in tidal friction.

The same conclusion manifestly applies to the work done by a tide-mill or any other mechanism in which the tides furnish the motive power.

It would further appear that as the mean value of $\tan(\Theta + \theta)$ is less than $\frac{1}{2}$, and that of λ cannot, on any probable hypothesis of the position of the tides, be supposed to exceed unity, the coefficient of $\frac{\Omega}{\omega}$ in the above expression is positive. Hence we may conclude that, as in the simpler case previously discussed, the small transfer of energy which accompanies the principal action takes place from the earth's rotation to the moon's orbit.

All these conclusions apply *mutatis mutandis* if we regard as our binary system the earth and sun.

In the case of nature, where we have to consider the three bodies acting together, the main conclusion that all the energy lost in tidal friction is drawn from the earth's rotation will not be invalidated.

Moreover, if we assume, as is generally done, that the friction varies as the velocity, the lesser effect, *i.e.* the concomitant, transfers its energy from the earth's rotation to the energy of the orbit of the moon about the earth, and that of the earth about the sun will correspond to the values separately calculated for the binary systems.

On the construction of large Nicol's Prisms, by W. Ladd.—In January 1869 I constructed two Nicol's prisms of about $2\frac{1}{2}$ in. aperture, which in the able hands of Mr. W. Spottiswoode and Dr. Tyndall have done much valuable work, and given rise to a great demand for such prisms, both in England and America; but as the length of a good Nicol should be about three times its diameter, very great difficulty is experienced in procuring pieces of spar of sufficient purity to give such a field.

This has given rise to various methods of utilising the spar by building up prisms of shorter pieces and combining them in such a way as to unite their field of view, such as utilising four prisms of 1 in. aperture, thus giving an aperture of 2 in. Another plan I adopted was to unite two whose diameter in one direction was double that of the other; these, being balsamed together, made a very good prism; but lately I had a very good piece of spar that, but for one corner of the rhombus, which was bad, would have made a prism $3\frac{1}{4}$ in. aperture. This was, therefore, too valuable a piece to be put aside.

I therefore cut it at the proper angle, which took away all the bad portion; I then took another piece half the length of the first, but of the same diameter, and cut this also at the proper angle, and the bringing the two ends together gave me another complete half; these, having been balsamed together and united with the first half, produced a perfectly good prism. I may add that it is essential that the two or more pieces constituting the half prism should have their cleavage planes exactly parallel, or the image would be bent at their junction.

SECTION B—CHEMICAL SCIENCE

On the Specific Volumes of certain Liquids, by Prof. Thorpe.—Kopp found that the specific volumes of certain elements varied. Thus, the specific volume of oxygen "within the radicle" = 13·2, "without the radicle" = 7·8; of sulphur, "within the radicle" = 28·6, "without the radicle" = 22·6. "Within the radicle" was defined as meaning an instance where the oxygen or sulphur atom is united by *two* bonds to the binding element, while upon "without the radicle" it is united by only *one* bond. Kopp announced that members of the same chemical family have identical specific volumes. The author determined the specific volumes of vanadyl trichloride, $VOCl_3$, and phosphoryl trichloride, $POCl_3$, and found in the former case that the specific volume = 106·5, while in the latter it = 101·5. Kopp's law does not therefore hold in this instance. The following examples also show that as the atomic weight increases the specific volume also increases :—

$SiCl_4$	specific volume	= 121·1
$TiCl_4$	" "	= 125·1
$SnCl_4$	" "	= 132·4

Another of Kopp's deductions is that isomers have the same specific volume; but the author found a difference between the specific volumes of ethyl-amyl and heptane, both of which are expressed by the formula C_7H_{16}; in the former case the number was 162·25, while in the latter it was 157·34. The author also determined the specific volume of the compounds PCl_3 = 93·7, $POCl_3$ = 101·5, and $PSCl_3$ = 116·3. Now, 101·5 – 93·7 = 7·8; that is to say, the specific volume of oxygen in $POCl_3$, is 22·6, hence it is without the radicle in this compound. So also 116·3 – 93·7 = 22·6; that is, the specific volume for sulphur "without the radicle." Hence the structural formula of these two substances $POCl_3$ and $PSCl_3$ will be

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     Cl
     |
Cl—P—O—Cl
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and

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     Cl
     |
Cl—P—S—Cl
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respectively; that is, in each case phosphorus is most probably a triad, not a pentad element.

On the Dissociation of Nitric Acid, by Messrs. Braham and Gatehouse.—Nitric acid when passed through an ordinary clay pipe at varying temperatures is split up : at the temperature of molten tin 2·10 per cent. is decomposed; at the temperature of molten lead 22 to 23 per cent. is decomposed; when the clay pipe is heated with gas 71·72 per cent. is decomposed, while when heated with charcoal 83·4 per cent. is decomposed. The gases evolved consist of oxygen, nitrogen, and nitrous oxide; the proportion of these gases it has been found very difficult to determine accurately. The following probably represents the reaction which takes place at minimum temperatures :—

$$8HNO_3 = 4NO_2 + 4H_2O + N_2O + N_2 + O_{11}.$$

When glass bulbs are partially filled with nitric acid and exposed to direct sunlight, the acid is decomposed, the amount varying with the time and intensity of the light; the decomposition is brought about by the violet end of the spectrum. If the bulbs are entirely filled with nitric acid, no decomposition ensues. After some time the decomposition ceases; this is due to the formation of nitrous acid, and if this is expelled by boiling, the decomposition again proceeds. If pure nitric acid be boiled, even to dryness, no decomposition takes place, but if the acid contains nitrous acid, then this latter is dissociated.

On the Replacement of Organic Matter by Siliceous Deposits in the process of Fossilisation, by Dr. Carpenter, F.R.S.—The author described several cases in which the internal casts of *Foraminifera* were found, consisting of silica, generally as silicate of iron. This process is now going on at the ordinary sea-bottom. Fragments of the spines of *Echinæ*, which originally contained protoplasm, have been found, in which the organic matter has been entirely replaced by silica, thus forming exact siliceous models of the animal matter. In some cases the siliceous deposit has preserved the exact form of thin tubes less than 1-10000th of an inch in diameter. The author supposed that during the gradual decay of the animal matter there had occurred a simultaneous deposition or substitution of siliceous matter in its stead.

On the Silicified Rock of Lough Neagh, by Prof. Hodges.—The water of Lough Neagh was found to contain only 12·95 grains of solid water per gallon; of this, 10·6 grains consisted of mineral matter, while 2·35 grains of organic matter were present. Of the total mineral salts a very small quantity only—less than 1 grain per gallon—consisted of ferric oxide. Samples of petrified wood were also examined : these contained on an average about 87 per cent. of silica, and a very small percentage of iron.

On a Self-registering Apparatus for measuring the Chemical Intensity of Light, by Prof. Roscoe, F.R.S.—In this communication the author described his already well-known self-registering photo-chemical apparatus.

On certain Abnormal Chlorides, by Prof. Roscoe, F.R.S.—The author drew attention to some of the chlorides of vanadium, tungsten, uranium, and sulphur. The highest chlorides which we have been able to obtain of these elements generally do not correspond with the highest oxides; thus, although we know of the oxides V_2O_5, we know of no higher chloride than VCl_4, and even this chloride is easily decomposed into VCl_3 and free chlorine. Although the oxide of tungsten, WO_3 is stable, yet the corresponding chlorine WCl_6 is very ready to split up into WCl_5 and free chlorine. So also UO_3 is a well-known oxide of uranium, yet until lately UCl_4 was the highest known chloride. The author has recently succeeded in preparing the penta-chloride UCl_5, which occurs as a light brown powder, and also as darker acicular crystals. Again, we have SO_2 and SO_3, but it is only very lately that SCl_4 has been obtained, and the compound is so unstable as to undergo dissociation at very low temperatures.—Dr. Debus suggested that the equivalency of many of the elements depends upon the element or elements with which they are united, and that hence these and other anomalous results.—The President remarked that he did not see why we should not expect to meet with examples of change of atomicity; that if we always found elements exhibiting an even, or always an odd number of atomicities, this was very remarkable, and called for explanation, but that we should not be surprised to meet with exceptions to the rule; indeed, that we could form no distinct physical idea of what we mean by "bonds of atomicity." He remarked that we cannot well use oxygen as a measure of atomicity, from the tendency which it so often exhibits of running into chains.

SECTION D—BIOLOGY

DEPARTMENT OF ZOOLOGY AND BOTANY

Dr. Moore called attention to a monstrous state of *Megacarpæa*, and also to a monstrous state of *Sarracenia*; after which he exhibited specimens of grafted roots of mangold wurzel, illustrating the transmission of special characters from the graft to the stock.

Mr. E. R. Lankester read a paper *On the genealogical import of the external shell of Mollusca*, in the course of which he referred to what has been called the recapitulation hypothesis, according to which all living things in their development present a rapid series of pictures or dissolving views of their ancestors, arranged in historical order. Applying this to the human race, he said that the earliest commencement of a human being was a small speck of protoplasm of mucus-like consistency, such as existed in ponds. A later stage exhibited him as a small sac, composed of two layers of living corpuscles, which he inherited from polyp-like ancestors, and was to-day seen in polyps. Still later he was an elongated creature, with slits in the side of the neck, which, like the gill-slits of a shark, he inherited from a shark-like ancestor. Six months after birth the child continued to inherit qualities from its ancestors, viz., from those which crawled on four legs; and at a later period certain irrepressible tendencies made it clear that qualities were inherited from climbing and shrieking animals. Mr. Lankester then went into an elaborate description of certain molluscs with a view of showing that the pen of the cephalopod is homologous with the shell of the lower Mollusca.

Prof. Huxley thought that the position had been well established. Mr. Lankester's attempt to reduce to one form the immense variety of shells in molluscous animals was exceedingly important.

Dr. Carpenter also said that he was almost prepared to receive the conclusion at which Mr. Lankester had arrived.

Dr. M. Foster added his testimony to the value of Mr. Lankester's observations, and said that part of the work accomplished was due to the establishment of the zoological station at Naples.

Mr. W. Archer read a paper *On a new form of Protozoa*,

Prof. Cunningham contributed a short paper *On two Species of Crustacea*, one belonging to the remarkable fresh-water genus, the *Atya spinipes*, and the other belonging to an apparently undescribed species of the genus *Pontonia*, which are remarkable for being found as tenants of the shells of living bivalve molluscs. The two specimens were found in the Singula Archipelago.

A paper, contributed by Mr. T. Lister, *On the Spring Migrating Birds of North England*, was read by Prof. Cunningham.

Mr. E. R. Lankester brought the subject of *English Nomenclature in Systematic Biology* before the department, and said it would be a considerable gain to science if there could be introduced a series of terms distinctly English in their etymology, which would be accepted as authoritative and used throughout the country. The only question was whether it was possible, by any action on the part of scientific men, to introduce such a series of terms. He suggested the appointment of a committee of men whose names would be received as authoritative throughout the country, to draw up a list of terms which should be used for the groups of the animal and vegetable kingdom.

A discussion followed, in which Prof. Thiselton Dyer, Mr. Bentham, Mr. A. W. Bennett, Prof. Cunningham, Miss Becker, Prof. Dickson, and Dr. Sclater took part, the generally expressed opinion being unfavourable to the change proposed.

A paper was read by Mr. H. Airy *On a peculiar form of Leaf-arrangement.*

SCIENTIFIC SERIALS

Justus Liebig's Annalen der Chemie, Band 172, Heft 3.—This part contains the following papers :—Communications from the chemical laboratory of Greifswald.—86. On metatoluidine, by F. Lorenz. The author describes the preparation of this substance. Paratoluidine is first treated with acetic anhydride, and para-acettoluide thus obtained, which, by treatment with nitric acid, yields metanitropara-acettoluide. By heating with alcoholic potash this latter substance is converted into metanitroparatoluidine; this last body is acted on by nitrous acid, and the diazo-compound treated with alcohol leaves metanitrotoluol, which, by reduction with tin and hydrochloric acid, gives metatoluidine. Several of the salts of this base are described, likewise the conjugate sulpho-acids, dibrominated substitution derivatives, &c.—87. Note on the quantitative determination of paratoluidine in presence of orthotoluidine, by the same author.—88. On metabromorthosulphotoluic acid, by Dr. E. Weckwarth. The preparation of this acid, which possesses the formula $C_6H_2\left\{\begin{array}{l}CH_3\\ SO_3\\ Br\\ N\end{array}\right. \!\!\!>N$ is described. The potassium, sodium, barium, strontium, copper, and lead salts have been analysed, and the chlorine, amido, and nitro substitution derivatives examined.—89. On orthoamidoparasulphotoluic acid, by Dr. M. Hayduck. The barium and lead salts are first described; the brominated acid and its potassium, barium, and lead salts are next treated of. The amido acid distilled with potassic hydrate gives off ammonia, and aniline and a potassium salt of anthranilic acid, $C_6H_3\left\{\begin{array}{l}H\\ NH_2\\ COOK\end{array}\right.$ is obtained. With hydrochloric acid and potassic chlorate the amido acid yields trichlororthotoluquinone, $C_6\left\{\begin{array}{l}CH_3\\ O_2\\ Cl_3\end{array}\right.$, from which the corresponding hydroquinone has been obtained. By the action of bromine on the amido acid a dibrominated acid is obtained, of which the barium salt has been analysed. Diazo-orthoamidoparasulphotoluic acid, $C_6H_3\left\{\begin{array}{l}CH_3\\ N\\ SO_3\end{array}\right. \!\!\!>N$, obtained by the action of nitrous acid on the amido acid, is next treated of. This body acted on by water gives orthocresolparasulphonic acid. The nitro-diazo acid is finally described.—90. On a new nitro-toluidine, by Dr. O. Cunerth.—On paramido-orthosulphotoluic acid, by Dr. F. Jenssen. The nitro-acid, $C_7H_6(NO_2)SO_3H \cdot 2\frac{1}{2}H_2O$, and several of its salts are described, also the chloride and amide. The amido acid is then treated of, likewise its salts and substitution derivatives.—On some decompositions of pyroracemic acid, by Dr. C. Böttinger. This lengthy memoir is divided into three sections: the first treats of the decomposition of the acid in acid solutions, the second of its decomposition in alkaline solutions, and the third of its decomposition *per se*. Among other things the author describes in great detail the preparation and properties of uvic acid and its salts.—On acenapthene and naphthalic acid, by Arno Behr and W. A. Van Dorp. The authors have examined several of the salts of the acid, its methylic ether and anhydride. The constitution of the two bodies is also discussed.—Researches on the volume constitution of solid bodies, by Dr. H. Schröder.—K. Helbing contributes a paper on an examination of some benzene liquors, and one entitled "Research on a new earth resin." This resin is found in large masses in a stone quarry at Enzenau, between Tölz and Heilbrunn. Nineteen per cent. of the resin is soluble in ether, and nine per cent. in ether and hot alcohol. The insoluble portion contains iron pyrites and a hydrocarbon of the formula $C_{40}H_{62}$. The ethereal extract contains a substance of the formula $C_{40}H_{62}O_2$, melting at 192°. The hot alcoholic extract gave a substance of the composition $C_{40}H_{60}O_8$.—On cymene, by F. Fittica. The author establishes the identity of the cymenes from camphor, ptycholisol, and thymol, and furnishes evidence that the propyl contained in the cymenes is normal propyl. The isomeric oxy- and thio-cymenes are also treated of.—The constitution of benzene, by A. Ladenburg.—On derivatives of phloretin, by Hugo Schiff. The author treats of the preparation of phloretin, of phloretic acid, and phloroglucin, likewise of phloroglucide and of triphloretide. The present part contains the index for vols. 169, 170, and 171.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, Aug. 15.—Dr. H. Wild contributes to this number some suggestions for the consideration of the Permanent Committee of the International Congress on the question of the establishment of an International Meteorological Institution. Before the Congress at Vienna he was altogether in favour of the scheme, but now feels persuaded that one institution could hardly exercise the large functions proposed with advantage. The difficulty of directing from one spot a number of stations scattered over the globe would be great, the conditions of these stations would not be familiar, the construction of isobaric charts, &c., could only be undertaken with exact data and co-operation of the central national offices, and the modification of instruments, &c., would not be a proper task to be attempted at any one place, with its narrow range of climatic conditions. The failure of one of the central offices would cripple the results produced by the Institution, and, besides, the energetic working of these offices would be endangered if they were to delegate some of their present problems to the Institution. The national offices which now occupy themselves with general meteorology might bestow too much attention to local matters. These objections would be avoided if each central office were to attend specially to some branch of the meteorology of the globe mutually agreed upon; for instance, one to the preparation of synoptic charts, another to rainfall, and so forth. The results of the various lines of research could then be interchanged, and the failure of one office would not damage the work of the others. The establishment and maintenance at common expense of international stations proper in uncultivated countries, and the publication of their observations, Dr. Wild holds would be best undertaken by the countries to which these stand in the nearest relation. There would remain, then, for the Institution the work of interchanging the results and keeping up the relations of central offices, the arrangement of occasional Congresses, questions concerning instruments, and the like.—Among the *Kleinere Mittheilungen* we observe an abstract of the important report of Mr. Blanford to the Government of Bengal for the year 1873.

Poggendorff's Annalen der Physik und Chemie, No. 5, 1874.—In 1868 Prof. von Rath published some observations on a form of silica to which he gave the name Tridymite. It always crystallises in twin hexagonal prisms, and has a low specific gravity. His further observations show lines of division between the elements forming the twins, and in these lines the third crystal in tridymite is developed. There is a similar persistence of the division plane between crystals of humite, and analogous triple crystals in anorthite, and an interlacing of crystals in leucite; and he concludes that while two crystals cannot be united to each other in many crystal groups, yet they can be united to a third crystal. Fine specimens, three millimetres long, reaching him from the trachytes of Pachuca in Mexico, he has made full measurements. The crystals, however, are generally of small